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showing the guard cells, which lie at the bottom of the chimney-like structure.

F. L. Scribner gave some hints upon the making of drawings from botanical specimens.

Geo. U. Hays of St. Johns, N. B., sent a paper on the botanical features of New Brunswick, which was read by the secretary. The low temperature and damp air have affected the flora so that it is quite peculiar.

Professor Bessey described his herbarium cases which have doors which are readily removed entirely, and which he uses for tables by placing them upon trestles or flat backed chairs.

D. H. Campbell described the germination of *Botrychium* spores in so far as his observations had progressed. He succeeded in germinating the spores by constructing a box in such a way that the spores were under ground.

He also called attention to the crystals in the petiole of *Onoclea*.

J. C. Arthur exhibited specimens of Nepal barley (*Hordeum trifurcatum*) in which the awns take a hood-like development, and in this hood additional flowers are found. The structure is very puzzling, as it appears that here a flowering glume (outer pale of the older books) bears flowers towards its upper extremity.

Dr. Walker, of New Orleans, mentioned a case of degeneracy of Indian corn. Kernels of Nebraska corn were planted in a pot in New Orleans, and produced perfect fruiting plants only fifteen inches in height.

The officers for the next meeting are John M. Coulter of Crawfordsville, Ind., chairman; J. C. Arthur of Geneva, N. Y., secretary.

The excursion on Monday afternoon to Tamarack swamp was very enjoyable, and to the younger botanists very profitable.

#### ENTOMOLOGY.

DR. BRAUER'S VIEWS ON THE CLASSIFICATION OF INSECTS.—In a work entitled "Systematisch-zoologische Studien," extracted from the ninety-first volume of the Proceedings of the Academy of Sciences at Vienna, Prof. Brauer, after a long introduction on evolution, makes many valuable and suggestive remarks on the following subjects: The insect orders now existing did not originate from one another but from ancestors closely allied to one another; affinities of Eugereon; the forms of insects the earliest and last to appear in different formations; hypothetical ancestral forms; no primitive forms connecting the existing orders of insects yet found; necessity of the dismemberment of some existing orders which are now mingled together; how the orders should be characterized; thoughts on the origin of the winged insects; division of insects into originally wingless, and secondarily winged or wingless forms; relations of the mouth-parts in larvæ and imagines or

their different changes of form; necessity of the increase in the number of orders based on the structure of the mouth-parts; relations of the parts of the thorax; relation of the thorax to the hind-body (1. Value of the relations of the abdomen to the thorax and organs of locomotion. 2. Ancestral forms, retrograde developments); genealogy; deceptive similar adaptive forms of different orders give the delusive appearance of a common descent or of a union in a single order; basis of the establishment of a peculiar (*eigenen*) order; the nymph as the stopping place (*anhaltspunkt*) for genealogical researches; the larva and genealogy; homologies of the nymph stages; relation and similarities between the ametabolic and metabolic insects; registered or artificial orders; how valuable the secondary or primitive larval forms may be to the systematist; orthognath and hypognath larva and imago; what points are to be considered in the use of the larvæ in classification; systematic characters of the same; characters taken from the structure of the nervous system; relations of the young form to the grown-up animal within the limits of a single order which are important for the determination of the grades of development; Packard's superorders; position of the sixteen series of forms not connected by intermediate links; relation of the allied series in different directions; view of the groups considered as orders; supposed greater allied groups; and, finally, the characteristics of the subclasses and orders of insects.

Professor Brauer claims that exact researches on the existing insects lead to the establishment of sixteen groups, or orders, which are not connected by intermediate types. "The path to a common ancestral form is interrupted in many places. Moreover, fossil remains do not fill up the gaps." The fossils yet discovered show, he adds, that our so-called orders of insects have a high antiquity, for we find in the Paleozoic strata typical representatives, and indeed highly developed forms; he adds, emphatically, that there are no connecting types between the orders now in existence. He regards Dohrn's *Eugereon* as a synthetic type, but not Scudder's *Atocina*, *Homothetidæ*, *Xenoneuridæ*, *Palæopterina*, *Hemeristina*, or Goldenberg's *Palæodictyoptera*, which he considers as belonging to existing orders, remarking that "the collection of oldest known insects consists of genuine Orthoptera (*Blattidæ*, *Phasmidæ*, *Mantidæ*); of amphibiotic Orthoptera (*Odonata* and indeed, perhaps, *Gomphidæ*, which were related to *Stenophlebia*, in the Devonian), genuine Neuroptera (*Sialidæ* in the Devonian), and *Rhynchota* (*Fulgoridæ*), which differ only generically from the forms now living; or even, taking into account the more general generic characters, belonging to forms now living."

Brauer, after further suggestive remarks on the relations of the fossil insects to the existing orders, maintains that there are too

few orders of insects generally recognized. While 2300 species of mammals are distributed into sixteen orders, the more than 200,000 species of insects are placed in eight or nine orders. He also criticises the too brief descriptions of our orders of insects usually given. He divides the insects (Hexapoda) into two classes<sup>1</sup> *Apterygogenea* (Synaptera of Packard), which is opposed to all the other insects which he calls *Pterygogenea*; the latter class he divides into six superorders and the latter into sixteen orders, which are described at length.

The six superorders are as follows, beginning with the lowest:

1. Orthoptera (in the wider sense of authors and of Gerstaecker).
2. Thysanoptera.
3. Rhynchota.
4. Petanoptera (Neuroptera, Panorpatæ, Trichoptera, Lepidoptera, Diptera and Siphonaptera).
5. Coleoptera.
6. Hymenoptera.

The sixteen orders are as follows, beginning with the lowest:

1. Dermaptera.
2. Ephemeridæ.
3. Odonata.
4. Plecoptera (Perlariæ).
5. Orthoptera (Blattidæ, Mantidæ, Phasmidæ and Saltatoria).
6. Corrodentia (Mallophaga, Atropina, Psocidæ and Termitidæ).
7. Thysanoptera (Thripsidæ).
8. Rhynchota (Hemiptera).
9. Neuroptera sensu str. (Megaloptera and Sialidæ).
10. Panorpatæ.
11. Trichoptera.
12. Lepidoptera.
13. Diptera.
14. Siphonaptera (Aphaniptera).
15. Coleoptera.
16. Hymenoptera.

Space forbids any farther abstract of Brauer's important paper, or offering any criticisms. We are, however, by no means opposed to the dismemberment of the Pseudoneuroptera, and are inclined, with Brauer, to recognize the Panorpatæ as a group of equal importance with the Trichoptera. We are also impressed with the belief that the orders of insects are more numerous than usually accepted.—*A. S. Packard.*

HISTOLOGY AND EMBRYOLOGY OF INSECTS.—The investigations of M. Weismann upon the changes which take place in the pupa state of insects are well known. M. Viallanes has followed in the same path, and a recent issue of the *Revue Scientifique* has

<sup>1</sup> Saussure's Hemimerus is regarded as unlike all other insects in possessing four and not three pairs of jaws, and "must form a new class."

given us a résumé of his memoir. He first studied the tissues of the larva and of the imago, and then followed out the mode of destruction of the larval tissues and the mode of genesis of those of the perfect insect. In his researches upon the nervous system of insects he found that besides the ganglionic chain and the stomato-gastric system, certain insects possessed nervous ganglia under the integuments, in some cases distributed without apparent order, but in others grouped symmetrically and connected with the principal centers. Another discovery was, that the sensitive nerves, when they arrive immediately below the hypoderm, enlarge into multipolar ganglionic cells, which anastomose in such a way as to form a rich subcutaneous plexus, the final branches of which end by free extremities under the hypodermic cells. Thus every part of the tegument has general sensibility. It has long been recognized that some of the hairs, or hollow conical outgrowths of the chitinous cuticle secreted by the hypoderm, were special organs of touch, and were accompanied by a nerve which formed a ganglionic bipolar enlargement. M. Viallanes has proved that the hair is secreted by a specially modified hypodermic cell, and that in the protoplasm of this cell the terminal prolongation of the bipolar nervous cell ends. The dorsal vessel of an insect is formed of a single layer of cells, but each cell is contractile through the presence in it of striated muscular microscopic fibrils. Each of these fibrils begins and ends in a small disc. A theory, generally admitted, holds that the active unity of a muscular fibril must be the space between two small discs, but this is the first verification of the theory.

The voluntary muscles of vertebrates exhibit little variety even in different zoological groups, and in any species have the same structure throughout. But in insects the motor muscles of the wings differ from those of the legs, and the contractile tissue of the larva from that of the adult. In the muscles of the wings of a fly the fibers (*faisceaux*) have no sarcolemma and only a few fibrils (*colonnettes*); in those of the wing of *Dytiscus* the fibers have no sarcolemma and only a single colonette or fibril, while in those of the legs the single fiber is enveloped in a sarcolemma. The ultimate elements, however, are the same in all. Previous histologists had proved that the motor nerves of the muscles of the legs of insects separate into their constituent fibrils immediately after penetrating the sarcolemma, but M. Viallanes shows that in insect muscles consisting of several fibers the nerve branches like a tree, as it does in vertebrates, while it separates at once into its constituent fibrils in muscles formed of but one fiber.

The second part of the memoir of M. Viallanes treats of the destruction of the larval tissues. M. Weismann had proved that the muscles, tracheæ, adipose bodies and peripheric nerves of the larva disappear entirely during the metamorphosis. M. Viallanes

finds that while some muscular fibers simply degenerate and are dissolved in the cavitary fluid, others change into cells which proliferate elements resembling the vitelline granules of birds and reptiles. These multiply exceedingly, the contractile substance disappears before them, and finally they disperse in the general cavity of the nymph. The tracheæ and salivary glands become filled with embryonic cells till the whole organ becomes embryonic, and its elements finally separate and disperse in the general cavity. The whole process is similar in its nature to the breaking down of vertebrate tissue in the morbid process known as inflammation.

The third part deals with the genesis of new tissues. It is singular that the integuments of the adult are not in any way derived from those of the larva. It was previously known that the larva contains within its body certain small white bodies disposed in pairs, and destined to form the head and thorax. The anterior pair are those of the head, while three superior and three inferior pairs in the following segments are those of the thorax, wings and legs. M. Viallanes has proved that the teguments of the abdomen are also formed from imaginal discs, but these abdominal discs are produced during the metamorphosis.

Each muscular fiber or bundle of fibrils is derived from numerous embryonic cells plunged in a homogeneous intercellular substance. The cells become the muscular nuclei, while the intercellular tissue becomes fibrillose and contractile.

The work ends in a detailed account of the development of the eyes. The eye of an insect consists of three regions: (1) The compound external faceted eye; (2) the ganglionic disc which forms a sort of screen between brain and eye; and (3) the optic ganglion which is the most external enlargement of the cerebral ganglion. M. Viallanes has traced the conducting nerve from an elementary eye or facet of the external eye, through the successive ganglia to the interior of the brain itself; and he shows that the germs of all the parts which enter into the visual apparatus exist in the young larva, enclosed within the brain, which they afterwards leave to take on their definitive form and occupy their destined position.

HORN ON THE ANISOTOMINI.—Dr. Horn remarks (*Entomologica Americana*, Vol. 1, No. 3, 1885): In the genus *Scotocryptus* the tarsi on all the feet are three-jointed. To this character Dr. Sharp attributes considerable value, and makes it the sole groundwork for the separation of a tribe which he places between the Anisotomini and Cholevini. From my own studies this numerical reduction of the several joints is only another step in the direction so plainly indicated in the genera already known. In order that the idea may be more readily grasped, the genera may

be disposed in the following order, the numbers referring to the tarsal joints:

|            |           |               |           |
|------------|-----------|---------------|-----------|
| Triarthron | 5—5—5, ♂. | Amphicyllis   | 5—5—4, ♂. |
| Stereus    | 5—5—5, ♂. |               | 5—4—4, ♂. |
| Hydnobius  | 5—5—5, ♂. | Agathidium    | 5—5—4, ♂. |
| Dietta     | 5—5—5, ♂. |               | 5—4—4, ♂. |
| Anogdus    | 5—5—4, ♂. |               | 4—4—4, ♂. |
| Anisotoma  | 5—5—4, ♂. | Agaricophagus | 4—3—3, ♂. |
| Colenis    | 5—5—4, ♂. | Aglyptus      | 4—3—3, ♂. |
| Cyrtusa    | 5—5—4, ♂. |               | 3—3—3, ♂. |
| Isoplastus | 5—5—4, ♂. | Scotocryptus  | 3—3—3, ♂. |
|            | 5—4—4, ♂. |               |           |
| Liodes     | 5—5—4, ♂. |               |           |
|            | 5—4—4, ♂. |               |           |

In a study of the above arrangement it will be seen that *Scotocryptus* follows naturally the course indicated by the genera which precede it. In order that the numerical combinations shall be complete, several new genera will have to be discovered, and the missing genera may be hypothetically indicated, as far as the tarsal structures, by any one whose inclinations run that way.

In the tribe Clambini the tarsi are 4—4—4 in both sexes in the genera known to me.

The antennæ of the Anisotomini exhibit a somewhat similar tendency to numerical modifications: First, by having nine or ten joints; second, by the variation of the number of joints composing the club, being either three, four or five.

ENTOMOLOGICAL NEWS.—*Entomologische Nachrichten* for August is mainly devoted to an article, by J. Schilde, on the secondary causes and relations in the markings of butterflies.—The structure of the halteres of Diptera has been studied by Mr. A. B. Lee. These organs were believed by Leydig to be organs of hearing. It appears, according to the abstract in the Journal of the Royal Microscopical Society for August, that there are two distinct organs contained in each of these structures, one an auditory organ, the other an organ of problematical function, which may be olfactory.—M. R. Zeiller describes the burrows made by the mole-cricket (*Gryllotalpa vulgaris*) in the clay soil at the bottom of a little pool of water that was sometimes nearly dry. These tracts, owing to their arrangement and the marks made on their surface by the insect in traversing its burrow, bear a striking resemblance to the impressions of certain fossil plants. They suggest a comparison with *Phymatoderma liasicum*, and present at the same time an analogy to certain impressions of conifers belonging to the genus *Brachyphyllum* (Jour. Roy. Mic. Soc., Aug.).—Apropos of the recent changes proposed in the classification of insects, by Packard, Scudder and Brauer, are the remarks of M. Preudhomme de Borre in the Comptes-rendus of the Entomological Society of Belgium for July 4.—The portion in Zittel's Handbuch der Palæontologie relating to fossil insects has been prepared by Mr. S. H. Scudder.